Submitted to

Los Angeles County

City of La Mirada System Architecture Diagram – Draft (Deliverable 2.1.7.1)

Gateway Cities Traffic Signal Synchronization and Bus Speed Improvement Project - I-105 Corridor (Phase II)

December 2005

Version 1.0

NATIONAL ENGINEERING TECHNOLOGY CORPORATION

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1. INTRODUCTION

The purpose of this document is to develop a detailed design for the Advanced Traffic Management System (ATMS) for the City of La Mirada as part of the I-105 corridor project. This document is based on the recommendations included in the *I-105 Corridor - Conceptual Design Report*. The City of La Mirada is one of the cities within the I-105 corridor that is planned to be a contributor of arterial traffic data to the Information Exchange Network (IEN) as part of the LA County ATMS. The system architecture for the I-105 corridor is shown in Figure 1-1. La Mirada is highlighted to indicate where this agency fits into the overall system. This system architecture is decomposed for the City of La Mirada into each system component that comprises the La Mirada ATMS. Subsequently each component is further decomposed to develop a detailed design that provides the basis for the list of required equipment and the allocation of system components to the various procurement vehicles for implementation in the City of La Mirada.

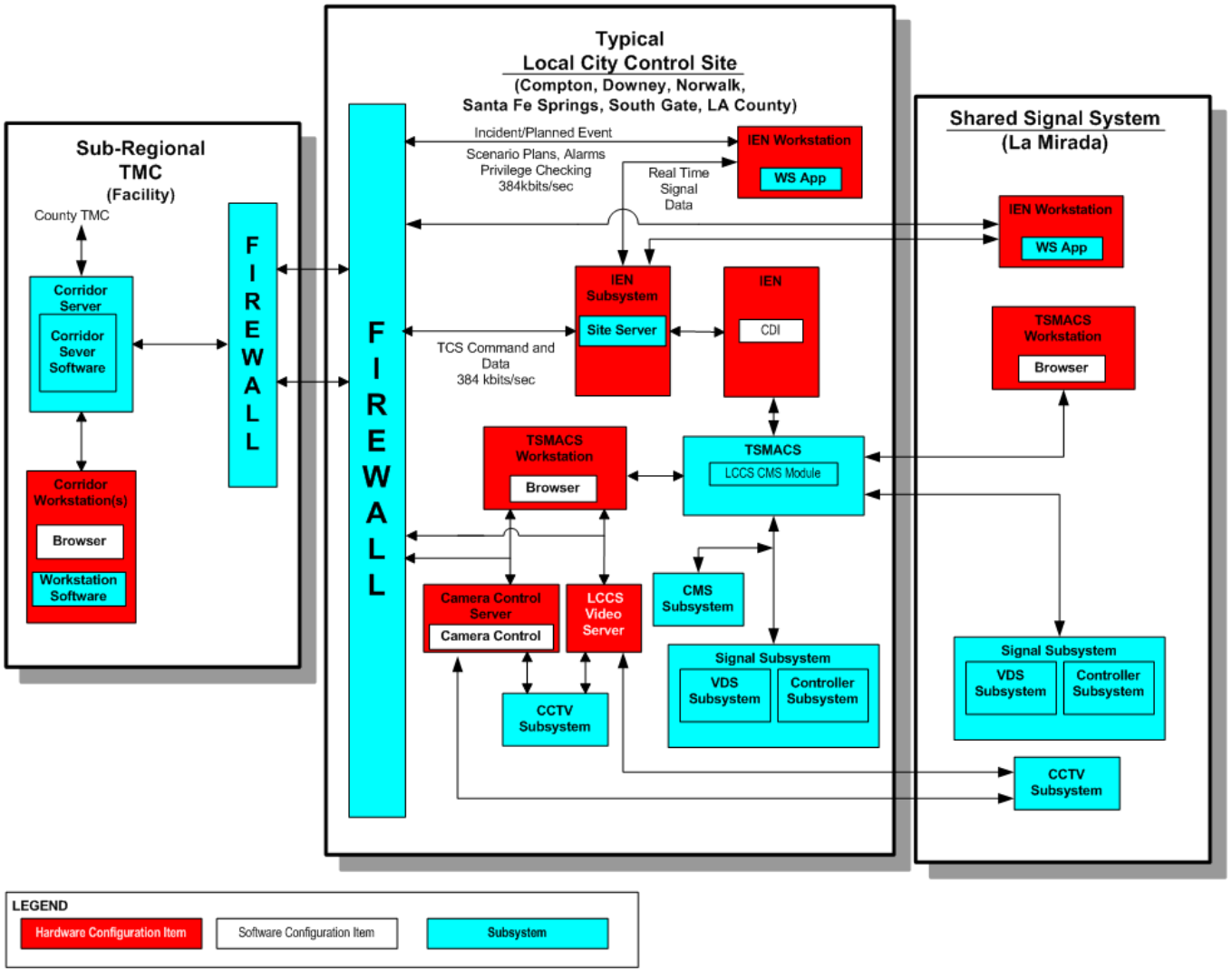

Figure 1-1: I-105 Corridor System Architecture

2. CITY OF LA MIRADA ADVANCED TRAFFIC MANAGEMENT SYSTEM (ATMS)

The Advanced Traffic Management System (ATMS) for the City of La Mirada consists of three subsystems: traffic signal subsystem, the video subsystem, and the communications subsystem that supports them. The configuration items in Figure 2-1 that are addressed in this document can be assigned the ATMS subsystems for the City of La Mirada as follows:

Traffic Signal Subsystem:

- Traffic Signal Monitoring and Control Subsystem (TSMACS)
- Controller Subsystem
- Vehicle Detection Station (VDS) Subsystem

Video Subsystem:

- Camera Control Server
- Video Server
- CCTV Subsystem

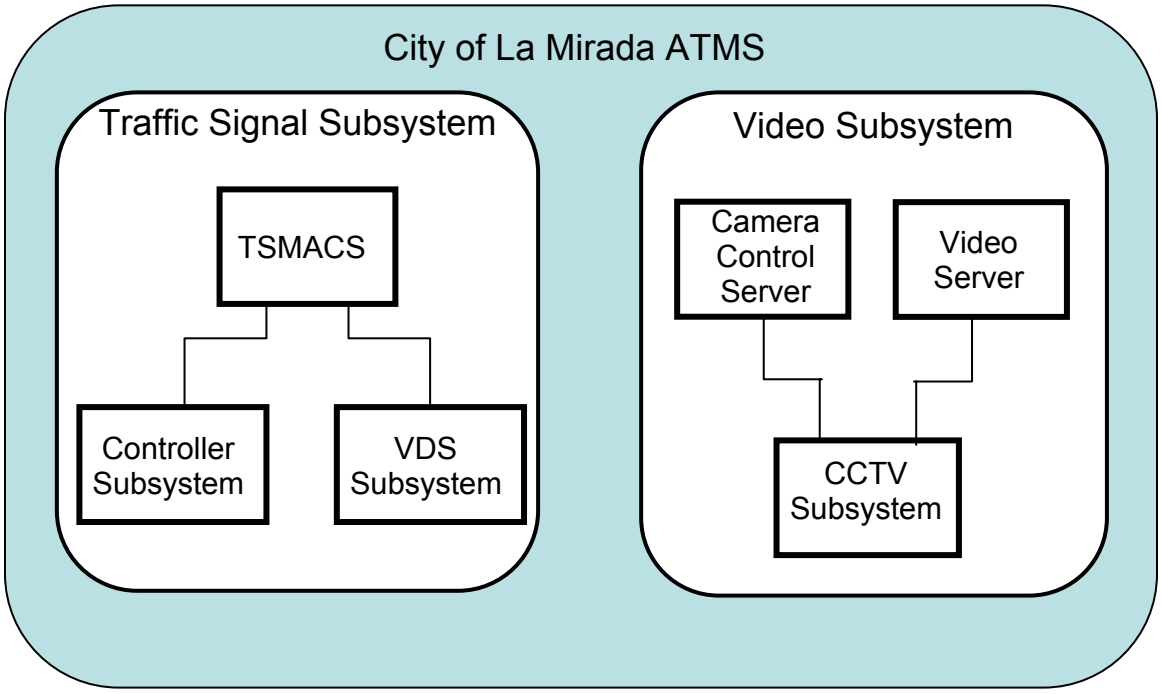

Figure 2-1: La Mirada ATMS System Architecture

The TSMACS servers as well as the Camera Control and Video servers are located at the LA County TMC. La Mirada ATMS consists of field equipment that is connected to the LA County TSMACS centralized servers. Remote workstations, located in the primary Local Control Center (LCC) and secondary LCC, are also connected to the LA County TSMACS servers.

Figure 2-2 shows the geographic locations of the proposed field components that are part of the ATMS in the City of La Mirada. These field components include CCTV cameras at signalized intersections and selected traffic signal controllers that are to be connected to the LA County TSMACS. The Primary LCC is to be located at the City Department of Public Works Maintenance Yard at 15515 Phoebe Ave. The Secondary LCC is to be located at City Hall at 13700 La Mirada Blvd.

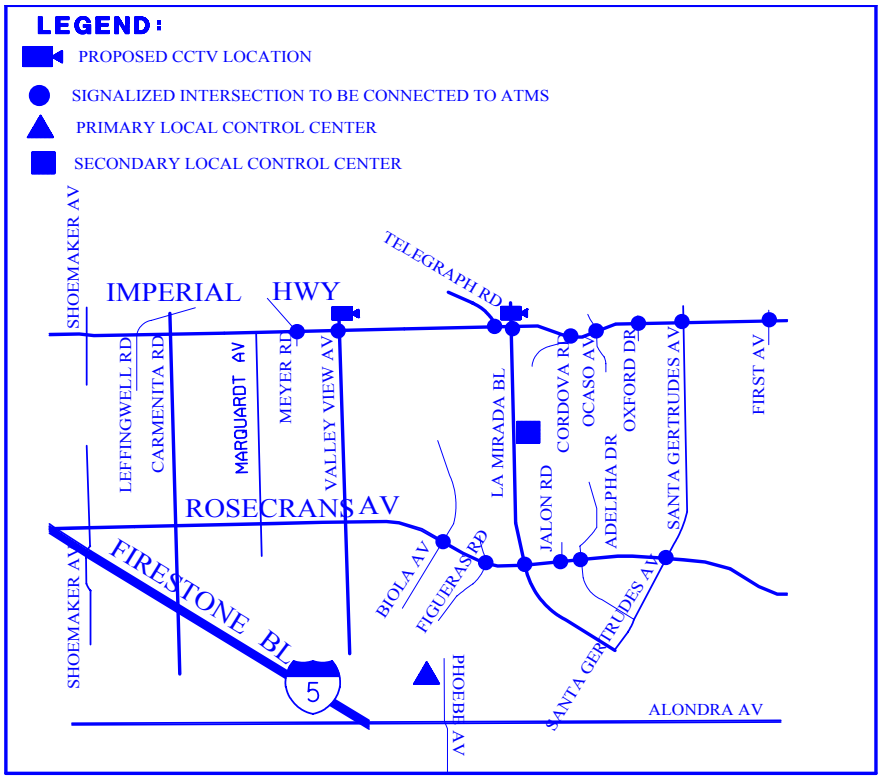

Figure 2-2: Geographic Layout for La Mirada Field Components

2.1 Traffic Signal Subsystem

The traffic signal subsystem consists of three components: the Traffic Signal Management and Control System (TSMACS), Traffic Signal Controllers, and Vehicle Detection Stations (VDS). In the following subsections, a functional description and the proposed design approach are provided for each component of this subsystem. Figure 2-3 depicts the equipment interconnection for the traffic signal subsystem. The traffic signal controllers collect traffic flow data from the advance detectors.

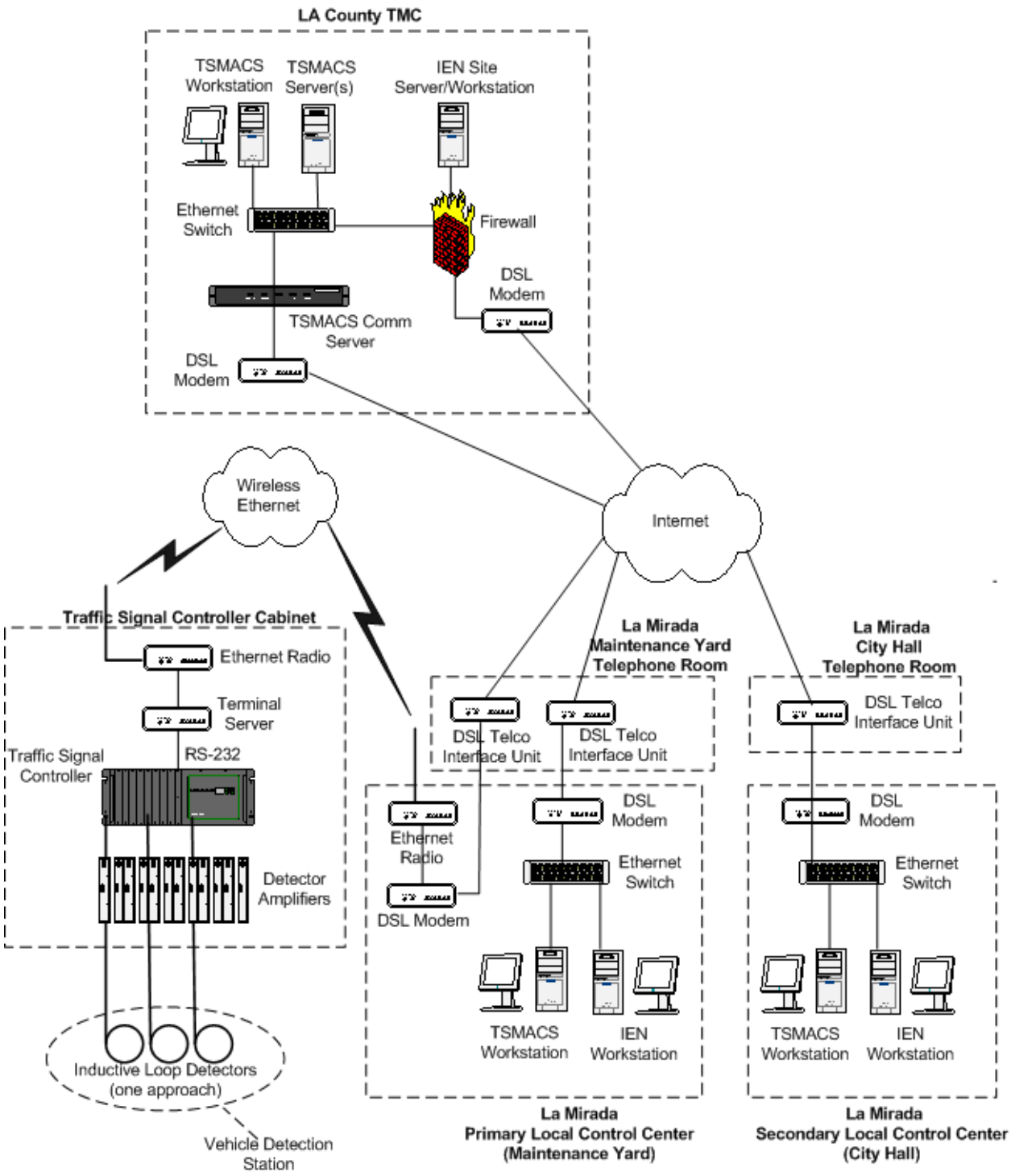

Figure 2-3: Traffic Signal Subsystem Physical Architecture Diagram

2.1.1 Traffic Signal Management and Control System (TSMACS)

The TSMACS provides the monitoring and control of traffic signals and interfaces with the traffic signal controllers. It is planned that the TSMACS server be located in the LA County TMC with remote TSMACS workstations located at the City Hall and the Maintenance Yard. Functional requirements were developed during the high-level design phase for I-105 Corridor project. These requirements can be grouped into the following areas:

- Traffic Signal (TS)
- Information Exchange Network (IEN)
- User Interface (UI)

Traffic Signal (TS):

TS functional area consists of the functionality related to traffic signal monitoring and control, as well as traffic data archiving and reporting.

Information Exchange Network (IEN):

The IEN area consists of requirements related to providing a data interface between the TSMACS and an external system. This allows the IEN to retrieve traffic data from each TSMACS for overall corridor coordination.

User Interface (UI):

The UI area consists of functionality related to the graphical user interface, such as dialogs and map displays for the TSMACS to control and monitor field equipment.

The Kimley-Horn KITS package has been selected for the TSMACS for LA County. Therefore, La Mirada will have one remote KITS workstation located at the Maintenance Yard (Primary LCC) and one remote KITS workstation located at the City Hall (Secondary LCC) and will conform to the system requirements included in the County's procurement document for KITS.

The following system components are included in the TSMACS subsystem:

- Traffic Applications Server – provides signal timing control and monitoring functions.
- Database Server – provides a repository for timing plans and system configuration data.
- Communications Server – provides the communications interface to the traffic signal controllers.
- User Workstations – provides the graphical user interface for operators to interact with the system.

2.1.2 Traffic Signal Controllers (TSC)

2.1.2.1 Functional Description

There are 15 signalized intersections that will have traffic signal controllers connected to the LA County ATMS. These locations are along Imperial Highway and Rosecrans Avenue. These controllers require upgrades to be compatible with the proposed TSMACS, which may consist of a firmware upgrade to the LACO IV firmware. Table 2-1 lists the intersections to be connected to the TSMACS.

Table 2-1: Proposed Traffic Signals to be connected to TSMACS

No.	Primary Street	Cross Street	Controller Type	Communications
1	Imperial Hwy	Meyer Rd	Model 170	Wireless
2	Imperial Hwy	Valley View Ave	Model 170	Wireless
3	Imperial Hwy	Telegraph Rd	Model 170	Wireless
4	Imperial Hwy	La Mirada Blvd	Model 170	Wireless
5	Imperial Hwy	Cordova Rd	Model 170	Wireless
6	Imperial Hwy	Ocaso Ave	Model 170	Wireless
7	Imperial Hwy	Oxford Dr	Model 170	Wireless
8	Imperial Hwy	Santa Gertrudes Av	Model 170	Wireless
9	Imperial Hwy	First Ave	Model 170	Wireless
10	Rosecrans Ave	Biola Ave	Model 170	Wireless
11	Rosecrans Ave	Figueras Rd	Model 170	Wireless
12	Rosecrans Ave	La Mirada Blvd	Model 170	Wireless
13	Rosecrans Ave	Jalon Rd	Model 170	Wireless
14	Rosecrans Ave	Adelpha Dr	Model 170	Wireless
15	Rosecrans Ave	Santa Gertrudes Av	Model 170	Wireless

2.1.2.2 Design Approach

Traffic signal controllers that are to be connected to the TSMACS are proposed to use wireless communications. This will be described in more detail in Section 2.3.

2.1.3 Vehicle Detection Stations (VDS)

2.1.3.1 Functional Description

Vehicle detection station (VDS) is a term that is used to describe a set of advance vehicle detectors on a single intersection approach. These detectors are typically about 300' to 400' from the intersection (depending on approach speeds) and are located in each adjacent lane. These vehicle detectors measure volume, occupancy, and speed or VOS (speed may be derived by the system) to allow the TSMACS to adjust timing when operating in a traffic-responsive mode. These vehicle detectors are also used for extending the green interval on a given phase when the controller is operating in free operation mode. The VOS data is typically retrieved by the TSMACS at end of a cycle or fixed frequency and used for traffic flow analysis or timing adjustments. The VOS data is also retrieved by the external systems such as the Information Exchange Network (IEN) to allow other agencies in the corridor to monitor traffic flow conditions on arterials that cross jurisdictional boundaries. In some cases detectors in separate lanes share a single Detector Lead-in Cable (DLC). A VDS with this configuration produces VOS data is not as accurate as VDS locations, which have a separate DLC for each lane. Several signalized intersection approaches are proposed to have additional DLC added to allow the VDS to measure VOS data from individual lanes. These intersections will be specified in the Plans, Specifications, and Estimate package.

2.1.3.2 Design Approach

Typically, when adding DLCs to an existing conduit run, the existing DLC must be removed and re-installed with the new cables. An additional detector amplifier is also required for each additional DLC to provide a separate input channel to the traffic signal controller.

2.2 Video Subsystem

The video subsystem consists of the following components:

- CCTV Camera Control
- Video Distribution
- CCTV Field Subsystem

Figure 2-4 depicts the physical architecture for the video subsystem.

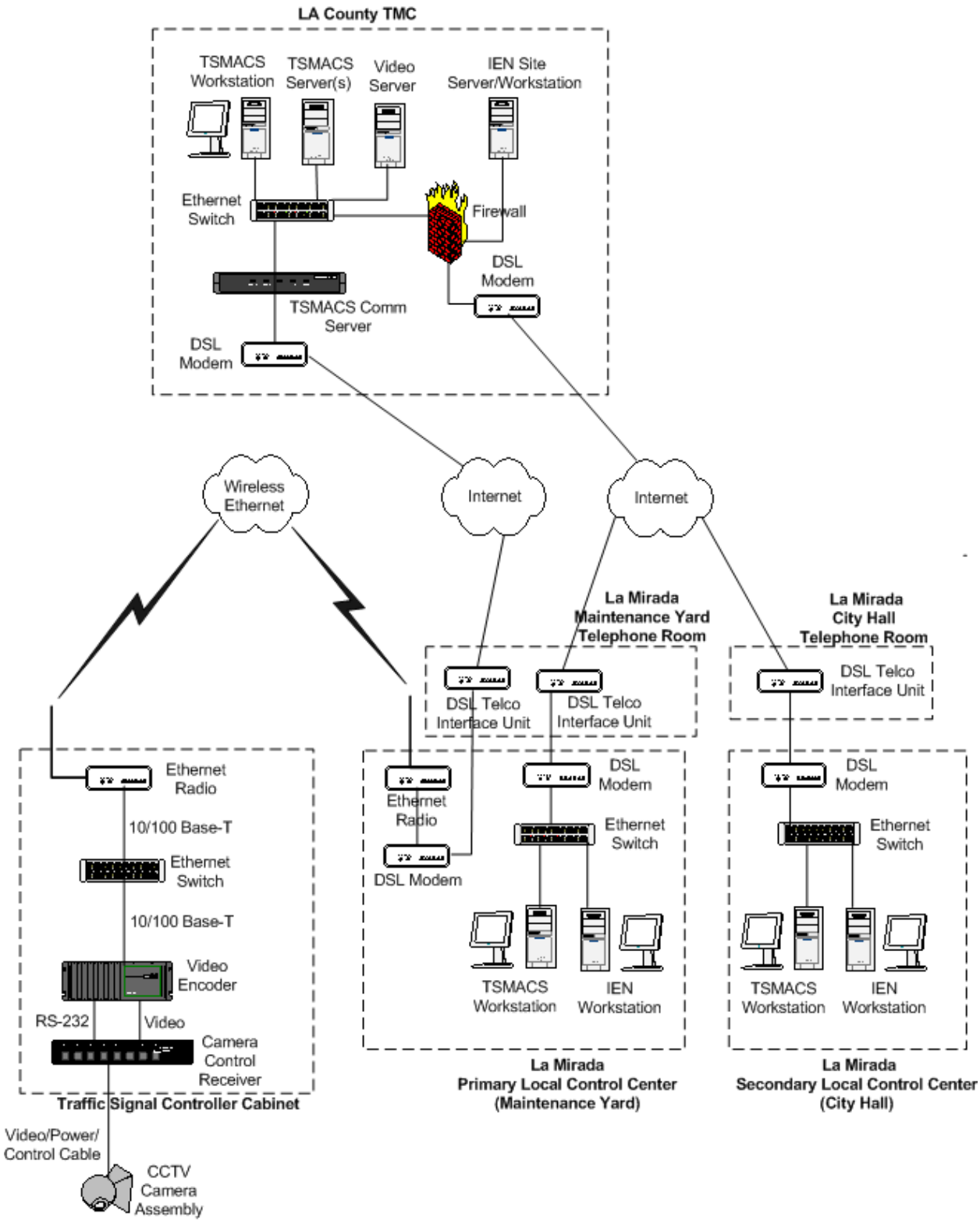

Figure 2-4: Video Subsystem Physical Architecture Diagram

2.2.1 Video Server

2.2.1.1 Functional Description

The Video Server consists of two basic components: video distribution and CCTV camera control. The Video Server may be included as part of the TSMACS package. The video distribution component provides the La Mirada ATMS (which is part of the LA County ATMS) with the ability to collect the video images from the cameras in the field and distribute the images to display devices within the La Mirada LCC and to other agencies in the I-105 corridor. The CCTV control component provides the ATMS with the ability to remotely control CCTV cameras from the Local Control Center (LCC). Control functions generally consist of panning, tilting, zooming, focus, iris, pre-set positioning, color balancing, and other features.

2.2.1.2 Design Approach

This Video Server is currently under design as part of Task 7, therefore this document addresses this component at a high-level. It is proposed that the City of La Mirada be consistent with the overall video distribution design approach for two reasons: 1) to facilitate the exchange of video images with other agencies in the I-105 corridor, 2) to have a consistent design within the PS&E package that is installing this system (which traverses three cities with fiber optic cabling and CCTV cameras). The IP-based video network acts as a video switching network by allowing users to select cameras and route the images to the desired display device. Each camera and display device has an associated IP address. Camera selection commands by the end-user are actually seen as origin and destination IP addresses by the IP-based network. A video server may provide this translation and to distribute the images from Norwalk to other agencies in the corridor. Due to the fact that these images may be transferred over both fiber optic networks and low-bandwidth networks, MPEG-4 or MJPEG encoding may be best suited for application in the City of La Mirada.

The CCTV camera control function consists of a user interface (either joystick or computer graphical user interface) communicating with a CCTV controller unit or server to send commands to the camera control receiver in the field. The communications link that supports the transfer of camera control commands between the LCC and the CCTV camera is combined with the video on the same wireless Ethernet link. A CCTV camera in the field is typically a serial interface. However this serial communications can be accommodated by a terminal server to allow data transfer over an IP-based backbone network between the LCC and the field equipment.

2.2.2 CCTV Subsystem

The CCTV subsystem consists of the CCTV camera field equipment located at selected signalized intersections.

2.2.2.1 Functional Description

The CCTV subsystem consists of the CCTV camera field equipment located at selected signalized intersections. The intersections listed in Table 2-2 are proposed to be CCTV camera locations.

Table 2-2: Proposed CCTV Camera Locations for La Mirada

No.	Cross Street	Communications
Imperial Hwy.		
1	Valley View Ave.	Ethernet Radio
2	La Mirada Blvd.	Ethernet Radio

The CCTV subsystem allows operators at the La Mirada LCC and at the LA County TMC to view video surveillance images at signalized intersections and control the position of these cameras for an optimum field of view for all approaches.

2.2.2.2 Design Approach

The CCTV camera location consists of the following equipment:

- CCTV camera assembly (camera, lens, pan-tilt unit) inside an environmental enclosure.
- Camera Control Receiver Unit
- Video Encoder
- Ethernet Switch
- Terminal Server
- Ethernet Radio

CCTV Camera Assembly

The design approach for CCTV camera locations is to mount a dome enclosure to an existing traffic signal pole just below the mast arm, as shown in Figure 2-5. The enclosure houses the camera, lens, and pan-tilt unit. A single cable egress is to be installed to allow a hybrid cable to be installed between the camera control receiver unit in the existing traffic signal cabinet and the CCTV dome enclosure. The hybrid cable consists of multi-conductors for camera control and power, as well as a coax cable for video transmission all contained within an outer jacket.

CCTV Interface Equipment

The CCTV interface equipment is to be located in the existing traffic signal controller cabinet using available shelf space. This equipment consists of a camera control receiver unit which relays camera control commands to the lens and pan-tilt unit. This unit also provides a video output port and camera control panel to reduce the need for a bucket truck during maintenance activities. This unit interfaces with the video encoder to transmit digital video images to the LCC and receive camera control commands from the LCC.

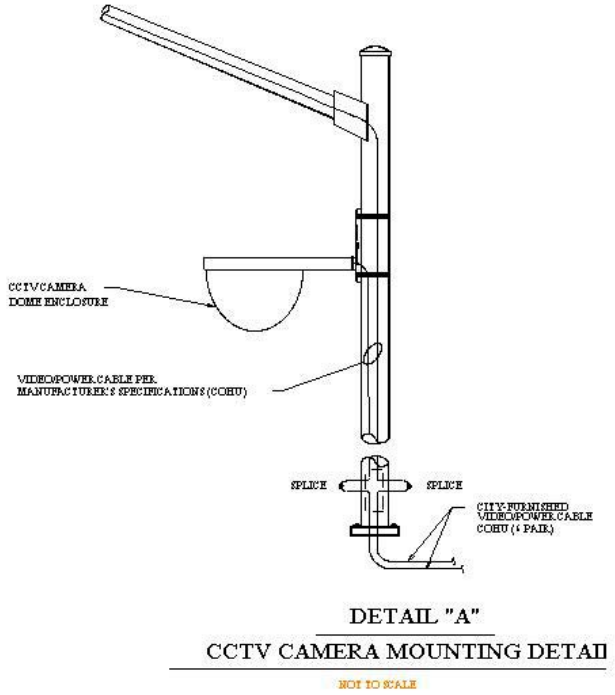

Figure 2-5: CCTV Dome Enclosure

2.3 Communication Subsystem

The communications subsystem supports the Traffic Signal and Video subsystem. There are two categories used to describe the communication subsystem for the City of La Mirada: 1) center-to-field and 2) center-to-center. Center-to-field is the part of the communication system that links the field equipment to the LCC for the transfer of data and video images. Center-to-center is the part of the communication system that links the La Mirada LCC with other agencies' LCC in the I-105 Corridor.

2.3.1 Center-to-Field

2.3.1.1 Wireless

In order to link signalized intersections and CCTV cameras, which are not located along a cable-based route, a wireless Ethernet radio communication system is proposed, as shown in Figure 2-6. The feasibility for utilizing this wireless technology must be further investigated with consideration given to line-of-sight issues and possible interference from other radio signals. For intersections that have a CCTV camera and a traffic signal controller, an Ethernet switch is proposed to allow three connections for: a video encoder, a traffic signal controller, and an Ethernet radio. The traffic signal controller will require a Terminal Server to convert serial interface to Ethernet for transmission over the Ethernet network. For intersections, with only a traffic signal controller, an Ethernet radio is to be installed in the cabinet and a Terminal Server is also required here to convert the controllers serial interface to Ethernet.

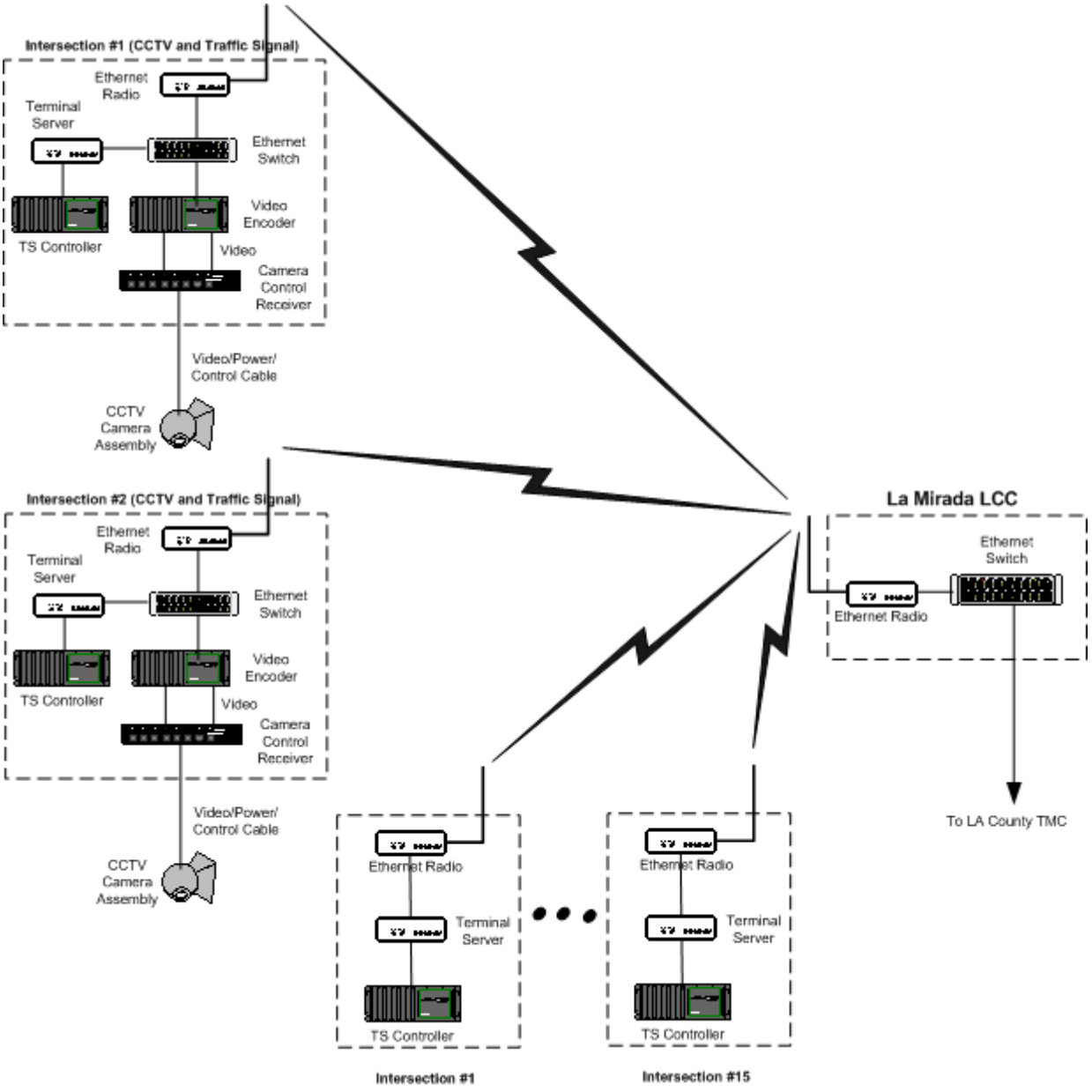

Figure 2-6: Communications Architecture (Center-to-Field) for CCTV and Traffic Signal Subsystem

2.3.2 Center-to-Center

DSL lines are used to link the La Mirada LCC to the sub-regional TMC at LA County. A single, 384 kbps line is dedicated for data exchange between these facilities. Two - 384 kbps lines are also allocated between La Mirada to and each of these agencies to allow a digital, compressed video to be transmitted to the LA County TMC.

3. LIST OF EQUIPMENT FOR LA MIRADA LOCAL CONTROL CENTER (LCC)

Table 3-1 lists the equipment that comprises the ATMS for City of La Mirada. Rack elevations and console layout are provided in *Deliverable 2.2.0.1 – Specifications for Console and Racks*. The floor plan layout for the La Mirada LCC is provided in *Deliverable 2.2.9.1 La Mirada Draft Site Report & LCC Layout.*

Table 3-1: List of Equipment for City of La Mirada

No.	Item Description	Qty	Mounting	Supplied by
1	TSMACS Workstation	2	Desktop/Tower	LA County
2	IEN Workstation	1	Desktop/Tower	IEN Project
3	Ethernet Switch (LAN)	1	Rack	Wireless Project (TBD)
4	Ethernet Radio	1	Rack	Wireless Project (TBD)
5	DSL Modems	5	Rack	IEN Project
6	Firewall	1	Rack	IEN Project